

REMARKS

In paragraph 2 of the last office action, independent claim 1 (and dependent claims 2-3 and 13) are rejected on the ground that they are anticipated by the teachings of U.S. patent 6,889,509. With regard to claim 1, the rejection makes particular reference to Fig. 8 of patent `509. According to the rejection, the "pressure reducing means" in claim 1 is shown by item 66 in Fig. 8 of patent `509.

To overcome this rejection, claim 1 is hereby modified to recite a method of maintaining an IC-module near a set-point temperature which is reduced in comparison to the cited `509 patent. In particular, claim 1 as modified calls for the step of "keeping said IC-module at a set-point which is colder than the boiling point of said liquid coolant at atmospheric pressure, by producing a sub-atmospheric pressure in said container throughout said spraying step".

By comparison, in patent `509 the only mention of any "sub-atmospheric pressure", or "vacuum", occurs in just four sentences. Two of those sentences are in the paragraph that runs from line 66 of column 6 to line 4 of column 7. The remaining two sentences are in the paragraph that runs from line 3 of column 8 to line 13 of column 8. What each of these paragraphs teaches will now be analyzed.

To begin this analysis, consider first the paragraph in patent `509 which runs from line 66 of column 6 to line 4 of column 7. This paragraph says that item 66 in Fig. 8 is a "vacuum manifold". According to this paragraph, the vacuum manifold 66 "draws" the liquid and

vapor from the spray housing and transfer it to the central unit 50 for condensing and thermal conditioning.

Thus, the above paragraph in patent `509 is merely describing the use of a vacuum as a vacuum cleaner. Nowhere does the above paragraph in patent `509 teach or suggest they use a vacuum to lower the set-point, for an IC-module, below the boiling point of a liquid coolant at atmospheric pressure.

Next, consider the paragraph in patent `509 that occurs at lines 3-13 of column 8. In that paragraph the sub-atmospheric pressure in the spray chamber 64 is described as occurring after the burn-in testing of the IC-module "is completed". According to this paragraph, the only reason for generating the sub-atmospheric pressure in the spray chamber is to remove any coolant that "remains" within the spray chamber "after" the burn-in testing the IC-module is completed.

See also column 2 at lines 52-55 which indicates that the invention in patent `509 is merely a scheme for recovering "liquid coolant that remains upon the burn-in boards . . . at the completion of a burn-in cycle". In this recovery scheme, the pressure in the spray chamber is reduced to sub-atmospheric at the completion of a burn-in cycle, which is when the temperature of the IC-module is no longer being controlled.

By comparison, claim 1 as amended covers a method which does control the temperature of the IC-module. In particular, the last step of claim 1 keeps the IC-module at a set-point which is colder than the boiling point of the liquid coolant at atmospheric pressure. Support for the claim 1 method comes from page 23 of the Detailed Description at lines 5-25.

The above cited portion of the Detailed Description says that the lowest temperature to which an IC-module can be maintained by spray cooling is "just slightly above the temperature at which the coolant droplet 40 vaporizes". See lines 10-13 on the above cited page 23.

This technical fact is established by equation 2 in Fig. 4. There, the first term $(\Delta T) (C_p)$ is the amount of heat that is removed from the IC-module when one gram of coolant water heats from the temperature at which it is sprayed to its vaporization temperature, and the second term 2260 J/gr is the amount of heat that is removed from the IC-module when the gram of coolant water evaporates. The description, on line 27 of page 20 to line 8 on page 21 says that the first term is so small in comparison to the second term that the first can be ignored.

Thus the lowest temperature which the IC-module can reach is just slightly above the vaporization temperature of the coolant. The lowest temperature which the IC-module can reach is not the temperature at which the coolant is sprayed. However, these technical facts are not taught by patent `509 because in that patent, the pressure in the spray chamber is not used to lower the set-point temperature.

Based on the differences which have been pointed out above, between claim 1 as amended and patent `509, it is respectfully submitted that the rejection of claim 1 has now been overcome. Also, since claim 1 as amended is now a method claim, this amendment changes all of the narrower dependent claims 2-13 to method claims.

Accordingly, entrance of this amendment and an early Notice of Allowance of claim 1, as well as its narrower dependent claims 2-13, is requested.

Respectfully submitted,



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December 14, 2005

